Portable Advanced PEM Fuel Cell Systems for Defense

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IDATECH™
An IDACORP Company
Advanced Fuel Cell Solutions™

Tri-Service Power Agenda

- ***IdaTech Overview***
- Core Competencies
- Defense Solutions & Applications
- Fuel Processing Technology
- Fuels
- Fuel Cell Systems

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IdaTech Overview

- Founded Northwest Power Systems
- IDACORP, Inc. (NYSE: IDA) purchased majority share in 1999
- 65 Employees
- Core competencies
  - advanced fuel cell solutions
  - patented processing technology
  - fuel cell system integration
  - electronic controls

Vicinity of IdaTech

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IdaTech Mission Statement

IdaTech's Mission is to be a world-class leader in the development, manufacture, sale and support of small-scale fuel cell systems and components for global portable and stationary applications.

IdaTech's Operating Principals

- Highest Personal Integrity
- Product Validation Before Market Entry
- Market-Driven Solutions

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Core Competencies

- Fuel Processing Technology
- Fuel Cell System Integration
  - PEM FC's Integrated w/ IdaTech Fuel Processors
  - Automation and Controls
  - Remote Monitoring and Diagnostics
- Customized Solutions
  - PV/FC Solution
  - 2 kW Solution for Army – CECOM
  - Natural Gas & Propane Test & Eval. Systems
- Research & Development

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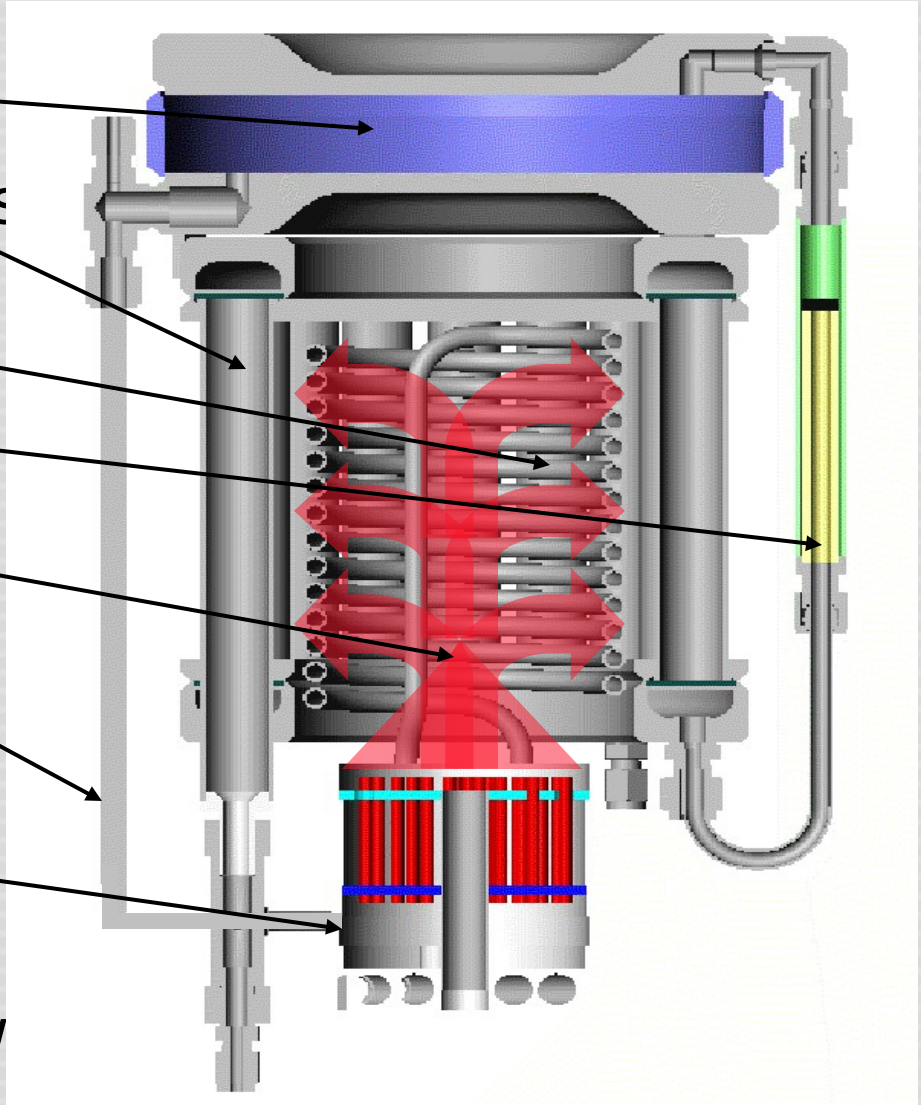
Fuel Processor Components

- Metal membrane
- Reforming catalyst tubes
- Steam generation
- Filter/H_2-Rich stream
- Combustion Products
- Waste from membrane
- Burner

*Hydrogen Port Not Show



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Hydrogen Purification Issues

- Bulk composition (H_2 content?)
- CO is not the only contaminant of concern

  - also: sulfur compounds, amines, ammonia, unsaturated hydrocarbons, aromatic hydrocarbons, hydrogen cyanide

- Need universal purification (PEMFC systems)

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Key Benefits

- High-purity product hydrogen (>99.95% H_2, typically <1 ppm CO and <3 ppm CO_2)
  - Optimize PEMFC power density and lifetime
  - Compatible with Alkaline Fuel Cells
- Very compact size
- Long life & time between scheduled maintenance
- Simple to control
  - Higher reliability
  - Lower cost (simpler control hardware)

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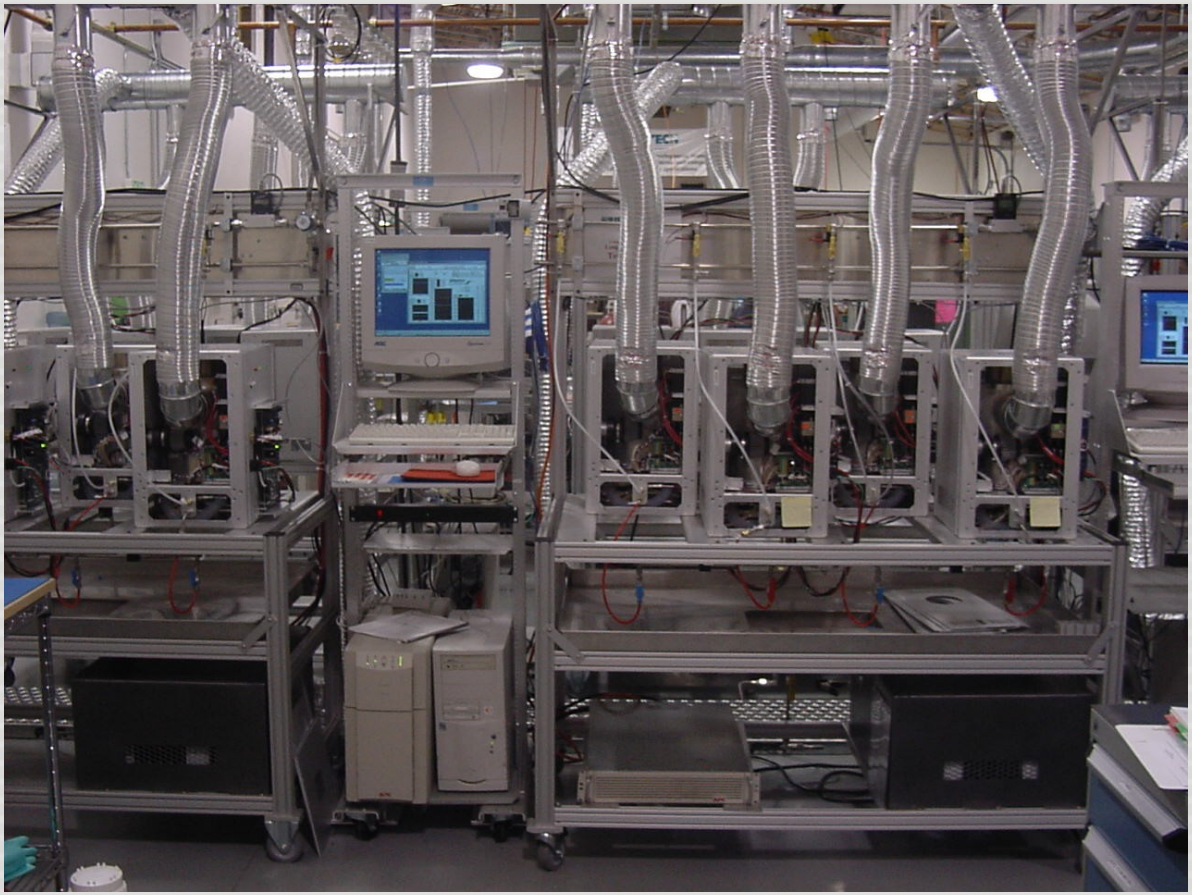
Reliability and Testing



Fuel Processor Automated Test Stand

System & Component Qualification & Endurance Testing:

Example – Processor

> 48,300 hours of aggregate fuel processor test program with fuel power modules

> 4,525 thermal cycles

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Fuel Cells for Defense Applications

- Efficient and Reliable
  - Greater than 10% efficiency gain compared with ICE generator sets
  - DC output, eliminating AC/DC conversion required for most electronics
  - Very few moving parts, reducing the MTBF
- Lightweight, reduced signatures
  - Volumetric and gravimetric advantages over ICE generators and most battery systems
  - Inherently quiet

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Fuel Cells for Defense Applications (continued)

- Lightweight … (continued)
  - No noxious emissions
  - PEM systems operate at low temperatures versus the 400+ ºC diesel ICE exhaust
- Clandestine or noise abatement operation
  - Fuel cell power provides operational capability where it has not been previously possible
- Operation within confined spaces
  - Fuel cells generate/cogenerate safely within an inhabited structure

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High Value Defense Applications

C&CS Shelter Power

Ground-Based Radars

APU - Silent Watch

Telecom Sites

Power for Portable Structures

Robotic Mule

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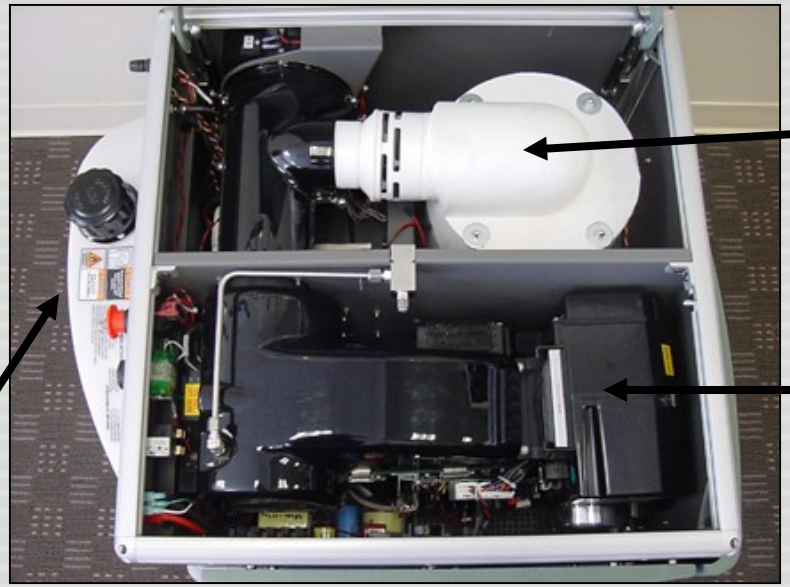
1 kW Compact Fuel Cell System

FCS 1200 v2.1

- Methanol/water fuel
- 1 kW net regulated 48 VDC
- Compatible with commercial inverters
- Automated operation
- Load following
- Universal remote monitoring available
- Mass 80 kg (180 lbs.)
- Dimensions 81 x 60



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2 kW Mobile Power Pac Mounted on Army Vehicle

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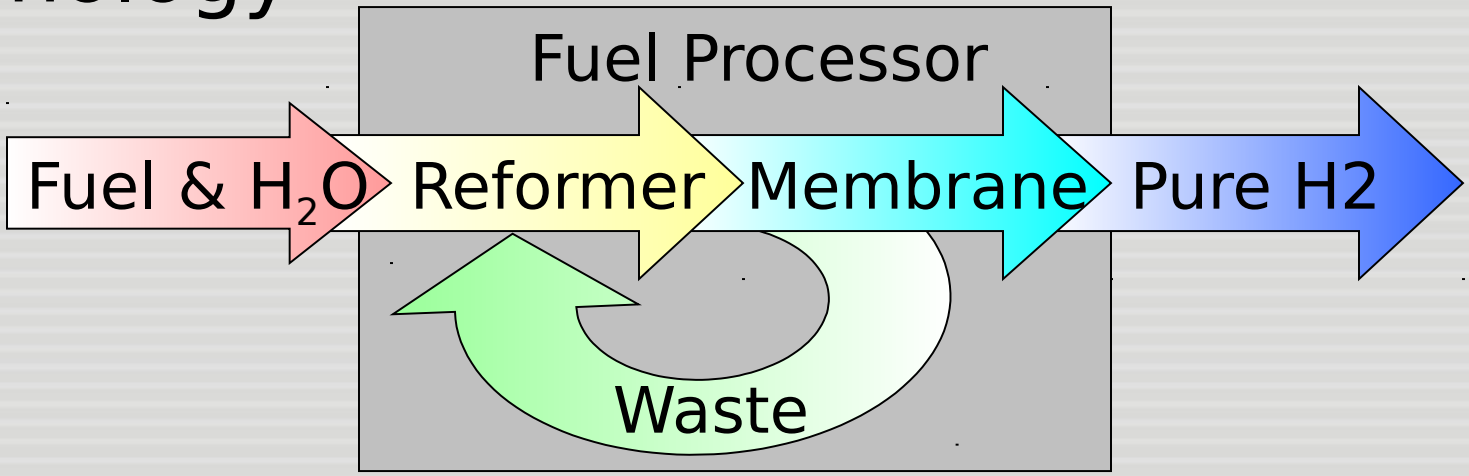
Universal Processor Technology



- Reformer converts logistic fuel to hydrogen-rich product stream
- Membrane Purifier selectively passes hydrogen, rejecting impurities to a burner
- Burner supplies thermal energy for fuel reforming and desulphurization catalyst

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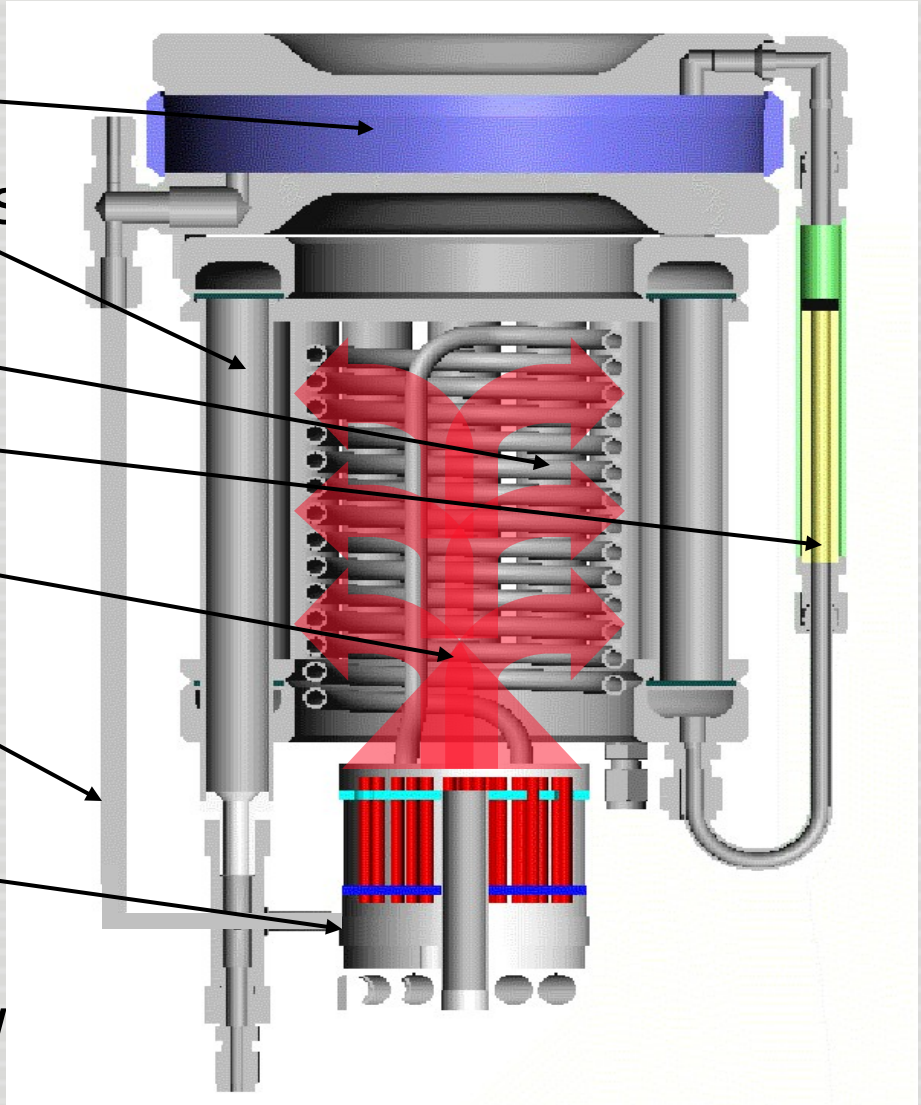

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Patented Membrane Purifier

- Sulfur Tolerant & Rejects Fuel Cell Poisons
- Thermally Integrated with Reformer
- Very Compact Plate and Frame Design
- High Purity Hydrogen (>99.95%)
- Passive, Requires no Controls
- Durable, 10,000 hour life validated
- Cost Effective, Replaces Multiple Unit Operations
- Liquid Fuels are Easily Pressurized

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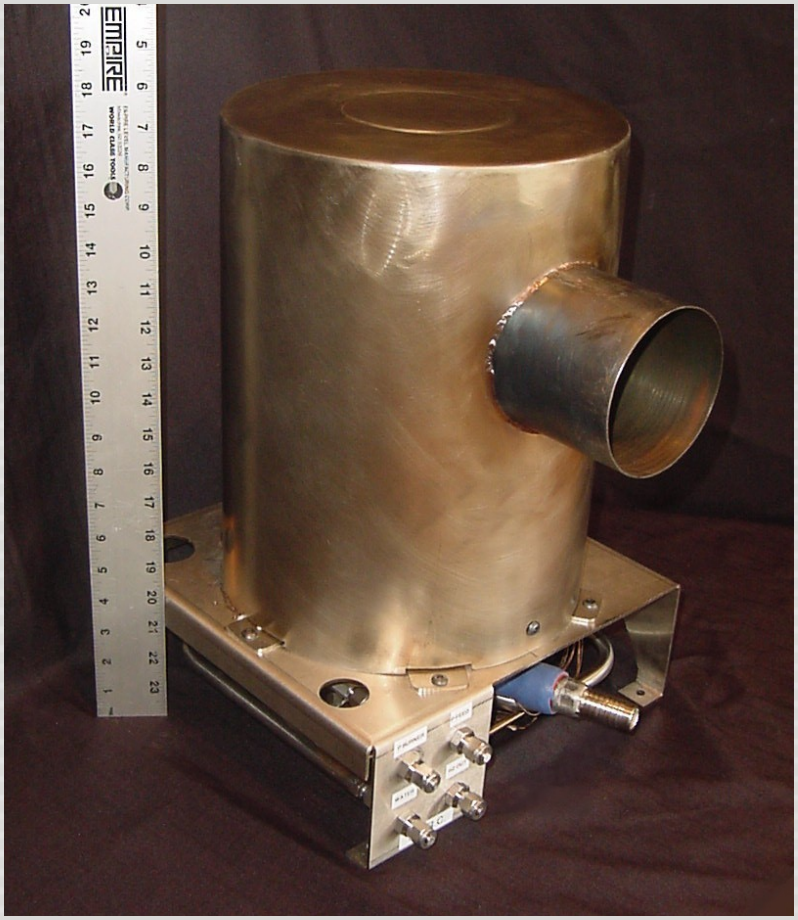
Fuel Experience



LPG fuel processor with purification unit (40 cm tall) delivers 25 sLm H_2 (>99.95%)

Liquid Hydrocarbons

- Low-Sulfur Diesel
- Kerosene
- Gas-to-Liquids (Fischer Tropsch Liquids, Syntroleum)
- Bio-Diesel
- White Gas

Alcohols

- Methanol, Ethanol, E. Glycol

Gaseous Hydrocarbons

- Natural Gas, Propane

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IdaTech Solutions

FPM Fuel Processor Modules

20 slpm Production

Commercially Available

FCS 1200™ 2.2 Fuel Cell System

Field Test Available

Targeted Availability 2H03

FCS 5000™ Fuel Cell System

Field-testing

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FPM™ Fuel Processor Module Family

Specifications

- Fully integrated subsystem
- Production rate 10 to 100 slm
- >99.95% H_2, <1 ppm CO, <3 ppm CO_2
- Quiet operation <50 db at 1 m (39 in.)
- 31 x 37 x 47 cm (12 x 14 x 18 in.); 36 kg (70 lbs)

Characteristics

- Simple integration, compact design
- Steam reforming, patented purification
- Provides hydrogen on-demand
- Embedded electronics and controls
- Module efficiency = 80%

Applications

- Integration with fuel cell systems
- Refueling & where H_2 is needed

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FCS 1200™ 2.2 Fuel Cell System

Specifications

- Rated 1.2 kW, 1 kW continuous output
- Fuel consumption 1.1 L/hr (0.35 gal/hr.)
- Mass 82 kg (182 lbs.)
- 81 x 60 x 50 cm (32 x 24 x 20 in.)

Characteristics

- Methanol / Water Fuel
- Integrated processor, Nexa™ fuel cell
- Automatic operation, one-touch start
- Universal remote monitoring
- AC or DC output
- System efficiency 27%

Applications

- Backup, Emergency, Premium power
- Market Development & Demonstration Tool

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1 kW Compact Fuel Cell System

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Prototype
LPG/NG/LHG

Fuel Processor
25 slm H_2
output

Desulfurizer
Module

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